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ABSTRACT

This study examined the relationship between students' perceptions of the two-way audio/video classroom and their anxiety, as well as their satisfaction with their distance learning experience. Students (n=222) in 12 two-way audio/video distance classes at two major midwestern universities and two midwestern community colleges completed inventories that measured their anxiety in the distance situation, satisfaction with learning in the distance environment, and perception of key elements in the two-way audio/video learning environment. Environmental variables were subdivided into perceptions of the physical environment, the physical layout, and the management of the distance learning environment. The data collected for each measure were correlated, and step-wise regression analyses were run. The findings indicate that there is a positive relationship between students' anxiety in the distance situation, their satisfaction with learning in the distance environment, and their perception of key elements in the two-way audio/video learning environment. In addition, key elements of the environment explain a significant portion of the variances of student anxiety in the environment and student satisfaction with the learning experience. Results of data analysis are presented in table form, and recommendations for further research are included. (Contains 24 references.) (DLS)

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Foundations for Creating Effective Two-Way Audio/Video Distance Education Environments

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Abstract

The promise for the successful use of distance technology is great. However, distance education is laden with the potential for student anxiety, brought on by the technology, that could hinder the effectiveness of instruction in such an environment. This study seeks to determine the relationship between students' perceptions of the two-way audio/video classroom and their anxiety. Additionally, it seeks to determine the relationship between students' perceptions of the two-way audio/video classroom and their satisfaction with their distance learning experience.

222 students in two-way audio/video distance classes completed inventories that measured their: anxiety in the distance situation, satisfaction with learning in the distance learning environment, and perception of key elements in the two-way audio/video learning environment. The data collected for each measure (anxiety, satisfaction, and key elements in the environment) was then correlated and step-wise regression analyses were run. The findings indicate that there is a positive relationship between student anxiety in the distance situation, their satisfaction with learning in the distance learning environment and their perception of key elements in the two-way audio/video learning environment. In addition, key elements of the environment explain a significant portion of the variance of student anxiety in the two-way audio/video environment. These environmental elements also explain a significant portion of the variance of student satisfaction with the learning experience.

In the past decade we have seen a technological explosion. This in turn has increased the growth and development of distance education programs. However, an unfortunate side effect of this rapid change is that much of the population has been left behind. As a result, people from all walks of life experience techno, or computer, phobia (Rosen & Maguire, 1990; Mahmood & Medewitz, 1989). Our study extends the ideas of earlier authors to an environment that was created as a result of this technological explosion: two-way audio/video distance education classes. In particular, this study explores the environment in a two-way audio/video classroom, its relationship to students' anxiety, and ultimately how it might affect interactivity and satisfaction with the learning experience.

Issues regarding interactivity, anxiety and satisfaction and the quality of learning experiences are not new. Educators have long realized the importance of interaction among students and instructors in facilitating the learning experience. However, in a two-way audio/video distance education environment these issues take on an even greater importance. Researchers have repeatedly stressed the importance of real-time interaction among people in a distance education environment (Barker, Frisbie, & Patrick, 1989; Wagner, 1994). Furthermore, distance education researchers have stressed the importance of student-instructor interaction in order to decrease anxiety and increase motivation (McIsaac & Gunawardena, 1996; Ehrman, 1990). In an extensive review of the literature, McIsaac and Gunawardena (1996) noted that nearly one-fourth of the literature was on this topic. Obviously, interaction is an integral part of a distance education class. Numerous methods can be applied to foster interaction, but one area that should not be ignored is student comfort. Student comfort, or the absence of anxiety, is essential in promoting interaction in a classroom.

One cause for concern regarding student anxiety in a distance education environment is that the physical distance between classrooms, the students, and the teachers can strip the class participants of the physical presence

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and comfort that can be found in a traditional classroom (Moore & Kearsley, 1996; Bruce & Shade, 1995). Two-way audio/video was originally seen as a solution for problems associated with the dispersion of members of the classroom. In essence, two-way audio/video was intended to promote the presence normally found in a face-to-face situation. In turn, this technology was also intended to foster better interaction, thus creating a better and more satisfying learning experience for the students. To a certain extent, two-way audio/video has met these expectations (McIsacc & Gunawardena, 1996).

These findings are supported by communications research. Researchers in this area have found, when examining interactions between people over two-way audio/video versus face-to-face situations, that people tend to communicate equally well in either situation. With respect to communication, there were little differences between the two mediums (Sellen, 1995; Heeter, 1992). Unfortunately, once technology is added to an educational situation things tend to lose their simplicity. Realizing this, Hillman, Willis and Gunawardena (1994) pointed out that although the two-way audio/video environment has the potential to provide real-time interaction, significant impediments might result if the student is not comfortable with the technology or if the technology is poorly implemented. We believe that anxiety induced by the physical environment in a two-way audio/video classroom will affect students' interaction and in turn their satisfaction.

The idea that anxiety has hindered learning is well established (Eysenck, 1979; Darke, 1988). It has also been established that when students are anxious, they will feel less comfortable speaking in groups (Weinberger & Engelhart, 1976). In sum, given a large classroom with a number of anxious students, it is likely that the overall quality of interaction and success of a class will suffer. There are numerous ways to combat this anxiety, but one way is to establish a safe and comfortable environment. In a traditional classroom where there are few and familiar environmental variables, this is relatively simple. However, in a two-way audio/video classroom there are numerous and less familiar variables. In addition, the use of technology itself can be quite anxiety-provoking for some individuals (Rosen & Maguire, 1990; Mahmood & Medewitz, 1989).

The physical environment is one of the foundations on which a comfortable anxiety-free classroom is built. Careful planning of a two-way audio/video classroom can ease communication and interaction; failure to do so can be not only unhelpful, but detrimental (Cape, 1996). Although a plethora of techniques can aid in reducing and facilitating communication and interaction in the classroom, using any of these methods in the absence of a sound foundation is analogous to a well-conceived building placed on a fault line. In the end, these interventions would collapse into the base from which they were built. Careful planning and judicious support in a two-way audio/video classroom play an important part in establishing a solid foundation.

There are several factors that should be addressed in order for a two-way audio/video class to be successful. Factors such as lighting, audio quality, table and monitor arrangement can all affect a student's anxiety level. In addition, unintelligible audio or video portions of the class can also create a whole new set of stressors that may hinder learning. Curiosity may induce some students to enroll in a video conference course, but others are likely to be unnerved by seeing themselves on the video monitor (Bruce & Shade, 1995). The technology in this environment can be particularly disconcerting for people. For this reason, the availability and response time of technical support staff in this type of environment is also crucial. If a problem with the technology arises and it is not resolved quickly, the anxiety and frustration level of all participants is likely to increase. Essentially it is important that the technology, environment, and support work together seamlessly, lest the environment become intrusive and anxiety-provoking thus compromising the level of interaction.

Although two-way audio/video classrooms have been around for over 40 years, there has been little empirical examination of physical environmental variables and, in particular, students' perceptions and satisfaction with them (Biner, Dean, & Mellinger, 1994). According to McIsaac and Gunawardena (1996) "... research is needed to identify how technology interacts with students and how it affects teaching and learning." Additionally, research on how the technology affects learners as well as the environmental conditions necessary for its implementation should be ongoing (McIsacc & Gunawardena, 1996.) This is especially true as the technology changes.

In this study we seek to develop a method by which to assess physical and environmental aspects as well as students anxiety in this type of environment and their overall satisfaction with their learning experience. Although many elements make up a solid foundation in the classroom environment, we believe that environmental variables are particularly relevant to student anxiety level, satisfaction, and ultimately student success in the classroom. Furthermore, it is essential that educators and programmers take these elements into account when developing and conducting distance education classes. The success level of the students, the instructors, and ultimately the distance education program can only be as good as the foundation on which it lies.

Method

Participants

The participants for the study were students enrolled in 12 separate two-way audio video classes at two major midwestern universities and two midwestern community colleges. The sample consisted of 222 subjects (146 female, 54 male, 22 non-reported; 93% Caucasian, 4% African American, 1% Hispanic, 1% Asian, 1% other). The age range for the sample was 18-64, with a modal age of 19 and a mean age of 31. 97% of the participants were native English speakers.

Instruments

The instruments used in this study included the following measures: anxiety in a two-way audio/video classroom, general satisfaction with the distance learning experience, and student perception of environmental elements of the two-way audio/video classroom. Environmental variables were subdivided into three categories: perception of the physical environment, perception of the physical layout, and perception of the management of the distance learning environment.

The measures in this study were developed due to the lack of empirically validated instruments that assess these constructs. Developing these measures was a multi-step process. The initial items were developed through a combination of techniques. In the case of the anxiety measure, items from the STAI: The State-Trait Anxiety Inventory (Spielberger, Gorusch, & Lushene, 1970) were examined and then modified to address specifically a two-way audio/video classroom situation. Additionally, the items in this inventory were designed in such a way that a high score would represent low anxiety. This was done so that there would be uniformity among the different measures. Thus, a high score on any of the measures would represent a positive attribute.

An approach similar to the development of the anxiety measures was used for developing the satisfaction with learning experience measure. Consumer satisfaction has been an important area of research in many fields (Ware, 1978; Lebow, 1982; Locke, 1976). In the past decade this area of research has gained interest in the area of education (Chadwick & Ward, 1987). As competition for students grows, particularly in distance education environments, schools will need to pay close attention to this variable lest their programs become victims of low retention and returns. Although the fields studied vary each seems to tap a certain unidimensional factor in its assessment of consumer satisfaction. Larsen, Attkisson, Hargreaves, and Nguyen (1980) in their development of Services Evaluation Questionnaire, found that three items defined a unidimensional measure of satisfaction.

1. To what extent has our program met your needs?
2. In an overall general sense, how satisfied are you with the services you received?
3. If you were to seek help again, would you come back to our program?

These three items were used as a guideline for the initial development of items to assess satisfaction with learning experience.

Finally, in developing a measure to assess environmental aspects of a two-way audio/video classroom, we interviewed ten distance education educators and four technicians from two large midwestern universities. Specifically we asked them questions regarding their own experiences and their students' perceptions of the distance education environment. This information was then summarized and categorized into different environmental issues for two-way audio/video environments. Individual items were derived from these categories.

Once the base set of items for each of the inventories was created, three experts in the field of distance education were given the items and were asked to rate how accurately the items measured each of the constructs. Additionally, a rating procedure was used in which 66 novices, students in educational psychology courses, were given definitions for each construct and asked to identify which construct each of the items seemed to measure.

The definitions used for each construct are as follows:

Anxiety: Fearful concern about performing and/or learning in a two-way audio/video classroom. Apprehension regarding one's capacity to cope with a two-way audio/video environment, despite having adequate preparation.

Satisfaction with the learning experience: How satisfied one was with their learning experiences in a two-way audio/video classroom.

Physical Environment: Perceptions of various physical characteristics of the two-way audio/video environment, such as audio, video, and so on.

Physical layout: Perceptions of the physical layout of a two-way audio/video classroom.

Management of the two-way audio/video classroom: Perceptions of how well the instructor and/or technology support team was able to manage successfully a distance learning environment. Management includes the support and use of the two-way audio/video technology, as well as regular classroom management.

Using these definitions, students were asked to categorize each item. Participants were allowed to choose one, multiple, or none of the constructs when making this decision. Next, concordance rates among these students were calculated.

The items eventually chosen for each of the scales had a wide range of frequency ratings from the novices. When examining these results, we looked at two specific areas. First we examined the percentage of identifications for the selected definition alone and then we looked at the number of identifications for something other than the selected definition. For the anxiety items there was a 64% - 91% selection of the anxiety definition alone with no other choices or combinations above 15%. For the satisfaction with learning experience there was a 26%-79% selection of the satisfaction with learning experience alone. The two items with the smaller confirmation rates also had confirmations of 25% and 17% for the no matches choice. The environmental variables, almost uniformly, were confirmed as one or a combination of the three environmental choices. The overall percentages for confirmations as one or a combination of the three environmental variables ranged from 48% - 98%, with only two of these items below the 75% rate. However, when these items were broken down into the three individual environmental categories the novices confirmation rate dropped considerably. The only category with reasonable sole confirmation rates was the physical layout, with confirmation rates ranging from 60%-85%. Of these items only one item, environmental perception, had an additional choice equal to or above 15%.

The concordance rates of all of these items were examined in conjunction with the expert ratings. Based on these results, items were divided among the previously stated constructs.

Finally, each of these items were given to the students in two-way audio/video classes. The students were asked to rate how strongly they agreed with each of the items. Ratings were given using a six point rating scale with one being **strongly disagree** and six **strongly agree**. Item analysis was performed using coefficient alphas. From this analysis 3 additional items were removed that did not, contribute additionally to the measurement of the construct in question and detracted from the overall homogeneity of the measure. From these procedures five scales were developed to assess each of the constructs in question.

The measures included items such as; "Talking on the camera frightens me" (Anxiety: 5 items); "I would take another two-way audio/video class" (Satisfaction with learning experience [SLE]: 6 items); "The lighting in the room is good" (Physical Environment [PE]: 7 items); "The layout of the room makes interacting with people at my site easy" (Physical Layout [PL]: 4 items); "The technology support for this course is good" (Management of the two-way audio/video classroom [MTAV]: 6 items). Reliability analysis was performed on each of the constructs. Each measure was found to have acceptable internal consistency (Anxiety = 0.87; SLE = 0.90; PE = 0.77; PL = 0.77; MTAV = 0.71). Final scores for each of the measures was obtained by adding each of the items for the specific construct and then obtaining the mean.

Procedures

The data collection took place over two semesters. Nine classes participated during the spring semester of 1997, and 3 classes participated during the fall semester of 1997. During the 13th week of class, a questionnaire was administered to each participant. The questionnaires consisted of several items assessing a variety of topics including the anxiety, SLE, PL, PE, and MTAV constructs. Before receiving this questionnaire the participants received an informed consent form, and they were asked to participate voluntarily in the study. Standard human subject procedures were followed as designated by each school's human subjects committee.

Analysis and Results

Scores on each of the five measures in question (anxiety, SLE, PE, PL, MTAV) were obtained for each of the students. Bivariate correlations were run on these scores. All of the measures were significantly correlated to alpha = .01 level. The results of the correlation are displayed in table 1.

Table 1. Bivariate correlations for anxiety, satisfaction with the learning experience, perception of the physical elements in the environment, perception of the physical layout, and perception of the management of the two-way audio/video classroom.

	Anxiety	SLE	PE	PL	MTAV
Anxiety	1.0				
SLE	.344**	1.0			
PE	.322**	.601**	1.0		
PL	.341**	.647**	.674**	1.0	
MTAV	.350**	.658**	.634**	.581**	1.0

(** Correlation is significant at .01, two-tailed.)

Next step-wise multiple regression analyses were performed to examine the contribution of the different physical environment aspects (PE, PL, MATV) to the constructs in question: anxiety and satisfaction with the learning environment. The results of the regression analyses are displayed in table 2.

Table 2. Step-wise multiple regression coefficients (standardized) for perception of the management of the two-way audio/video classroom (MTAV), perception of the physical elements in the environment (PL) and perception of the physical elements in the environment (PE). Anxiety and satisfaction with the learning experience are the dependent variables.

Variable	Anxiety	Satisfaction
MTAV	.229**	.376***
PL	.208**	.336***
PE	----	.136*
R squared	.151**	.547**

* $p < .05$
** $p < .01$
***$p < .001$

The results of the anxiety regression analysis (Table 2) indicate that together MTAV and PL explain a significant portion of the variance in students' anxiety with an R squared value of .151 (with $p < .01$). Additionally, MTAV and PL individually explain a significant amount ($p < .01$) of the variance in students' anxiety. The step-wise procedure excluded the independent variable PE in the anxiety regression analysis. The exclusion of this variable may be due to multicollinearity among the independent variables.

The satisfaction regression analysis (Table 2) indicates that together the three independent variables: MTAV, PL and PE explain a significant portion of the variance in students' satisfaction with the learning experience with a R squared value of .547 (with $p < .01$.) Individually, each of the three independent variables: MTAV, PL and PE explain a significant amount ($p < .001$) of the variance in students' satisfaction with the learning experience.

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Discussion

In this study, focus was placed on a few of the foundational elements of a two-way audio/video classroom. The results suggest that ignoring these elements can lead to a shaky foundation that will ultimately affect student anxiety and satisfaction with learning. In general, the results of the bivariate correlation indicate that there is indeed a significant positive relationship between students' perception of environmental aspects (physical elements, layout and management of the distance learning experience) and students' anxiety level and their satisfaction with the learning experience. Furthermore, the regression analysis provides support that the students' perception of the physical elements in the environment and the management of the distance learning experience explain a significant portion of the variance of the students' anxiety. Additionally, students' perceptions of the physical environment, the layout of the environment, and the management of the distance learning experience explain a significant portion of the variance of students' satisfaction with the learning experience. Last, there are some issues regarding our results that need to be investigated further, which we will discuss in detail below.

The items within each of the scales we developed, at face value, appear to be measuring different, but related constructs. However, as can be seen by the correlation analysis, they hold a very high relationship among themselves. In respect to the environmental perception sub-scales, caution should be exercised when distinguishing one of these specific aspects from another. This problem can be seen in the first regression analysis in which the PE variable was excluded. The fact that it did not significantly contribute to the explained variance of anxiety could be due to multicollinearity effects. It is important to note that the multicollinearity may not be the fault of the measures. It seems quite possible, given the distinction novices and experts attributed to the question in the measurement construction phase and the quite opposite finding when administering it to distance education students, that people simply do attribute different values to these distinct constructs. In other words, students may simply be answering all of the items in one general direction or the other and not making any finer distinctions. To better assess the environmental impact on student anxiety and satisfaction, a controlled experiment in which the environment was manipulated would need to be done. Yet despite these problems with the measures, they do hold promise for explaining overall perceptions of environmental aspects as well as a good beginning for further refinement in the measurement of specific environmental aspects in a two-way audio/video classroom.

As originally hypothesized, student anxiety and satisfaction are indeed related to their perception of environmental variables. This study provides the first steps in determining what can be done to help alleviate anxiety in a situation that for many is, by nature, anxiety provoking. In addition it provides yet another way to address student retention and ensure that future enrollments continue. Although the relationship appears to be fairly strong, the study leaves several questions for further exploration.

Further Research

The number of empirically validated measures that assess the environmental aspects of a two-way audio/video environment are few (Biner, Dean, & Mellinger, 1994). In fact we could not find any measures that specifically addressed this question. Thus, in the first portion of our study we sought to establish measures that could assess each of the various elements in the two-way audio/video environment (physical elements, layout and management of the classroom), students' anxiety level, and satisfaction with their learning experience. A multi-step process for developing these measures was used. Each measure had an acceptable internal consistency level and experts as well as novices provided ratings that indicated a high level of face validity. Although this is an important first step, additional data needs to be gathered so that validity can be established through other statistical techniques such as confirmatory factor analysis. Additional support for validity can be provided through an examination of the relationship between measures that examine the same or similar constructs. Finally, a controlled experimental study should be done in which elements in the physical environment are held constant. This will then assist in determining which elements in the environment are influencing students' attitudes. This will also help in determining if students' attitudes are influenced by their perception of different, distinct elements in the environment or as one overriding environmental construct.

The study sought to obtain a measurement of students' perceptions of the environment. This was deemed important because it is how students perceive the environment that is most likely to be related to their level of anxiety. However, before designers can make blanket decisions about how to create a two-way audio/video environment, the perception of environment must be validated against actual observations of the environment by experts. If it is found that students' perceptions are accurate, this can lead to further refinement and investigation into which aspects of the environment play an important part, in student's anxiety and/or satisfaction. Once these

relationships are determined further studies can examine if different layouts, types of equipment or support make a significant impact on the students' anxiety level and satisfaction.

In the immediate realm, the study provides evidence that the foundational elements in a two-way audio/video classroom – the physical elements of the classroom, the design of the classroom, and the support and management – are important elements in regards to students' anxiety and satisfaction with the learning experience.

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